Exposures to PM$_{2.5}$ associated with LPG stove and fuel interventions: Pilot results from the HAPIN Trial


ETHOS, 2019
Household Air Pollution Intervention Network Trial (HAPIN)

Funding

The trial is funded by the National Institutes of Health (NIH, grant number UM1HL134590), and the Bill & Melinda Gates Foundation. Participating NIH components are the National Heart, Lung, and Blood Institute (NHLBI), the National Cancer Institute, the Eunice Kennedy Shriver National Institute of Child Health and Human Development, the National Institute of Environmental Health Sciences, the NIH Common Fund of the NIH Office of the Director, and the Fogarty International Center. NHLBI leads administration of the trial on behalf of the consortium. The Global Alliance for Clean Cookstoves and the Global LPG Partnership provide expert advice to the consortium.
HAPIN Collaborators

- Emory University
- Rollins School of Public Health
- Johns Hopkins University
- Colorado State University
- London School of Hygiene & Tropical Medicine
- SRI Ramachandra University
- Universidad Del Valle de Guatemala
- Universidad Peruana Cayetano Heredia
- UBI Valladolid
- Berkeley Air Monitoring Group
- The University of Georgia
- The Global LPC Partnership
- University of Oxford
- University of St. Louis
- Harvard T.H. Chan School of Public Health
- Department of Global Health and Population
HAPIN Collaborators

Berkeley Air Monitoring Group
Colorado State University
Washington University

Harvard University
Global LPG Partnership
Johns Hopkins University
University of Georgia
Emory University (Coordinating Center)

Universidad del Valle de Guatemala (Guatemala Site)
PRISMA and Universidad Peruana Cayetano Heredia (Peru Site)

London School of Hygiene and Tropical Medicine (Rwanda Site) and
University of Oxford

Sri Ramachandra University (India Site)

College of Medicine and Health Sciences, Eagle Research Center (Rwanda Site)
Trial Aims

Determine the health impacts of a randomized LPG intervention on health in four diverse lower/middle income populations.

Establish exposure-response curves for primary and secondary outcomes.

Determine relationships between LPG intervention and biomarkers of exposure and health.

Note: Efficacy trial - LPG being provided for free
**Trial Study Design**

**Pregnant Women**
N=800 Rwanda  
N=800 India  
N=800 Peru  
N=800 Guatemala

**Older Adult Women**
N=200 Rwanda  
N=200 India  
N=200 Peru  
N=200 Guatemala

**Child**
N=800 Rwanda  
N=800 India  
N=800 Peru  
N=800 Guatemala

1. Screened for eligibility  
2. Baseline assessment  
3. Households randomized to intervention (n=1600) or control (n=1600)

Baseline assessment at enrollment  
Followed in utero and for 12 months after birth

Health measurements: **birth weight, child pneumonia (ALRI), child linear growth/stunting, adult blood pressure**, biomarkers, fetal growth, motor development, other chronic diseases

Exposure measurements: Repeated measures of PM2.5, CO, BC (sub-sample)
## Exposure plan overview

<table>
<thead>
<tr>
<th>Study Group</th>
<th>Measurement</th>
<th>Pre-intervention (&lt;20 weeks gestation)</th>
<th>24-26 Weeks gestation</th>
<th>32-36 weeks gestation</th>
<th>&lt;3 months*</th>
<th>~ 6 months</th>
<th>~ 12 months</th>
<th>Total Repeats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention Group (n=400)</td>
<td>Pregnant woman (PM2.5, CO, BC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Child (PM2.5, CO)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Other woman, 25% of households (PM2.5, CO, BC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Traditional stove usage</td>
<td>SUMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPG Usage</td>
<td>Cylinder tracking*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group (n=400)</td>
<td>Pregnant woman (PM2.5, CO, BC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Child (PM2.5, CO)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Other woman, 25% of households (PM2.5, CO, BC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Traditional stove usage</td>
<td>SUMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Will attempt to capture as close to neonatal period as logistics allow

*check with via questionnaire and one month of SUMS
Equipment

Stove usage:
Geocene Dot

Location: beacons

CO: LASCAR

PM2.5: ECM

Ambient PM:
E-Sampler
HAP Pilot Aims

Evaluate and gain experience with instrumentation and protocols

Gain an understanding of what exposure contrasts to expect and how they relate to current exposure-response curves
Pilot HAP design overview:

- Trial site selection informed by potential for low exposures

- 24-48hr personal PM$_{2.5}$ exposure of primary cook (mix of gravimetric instrumentation)

- Before (biomass) / after (LPG) with two follow-ups (0.5-3 months)

- Encouraged exclusive use of LPG

- Sample sizes 28-43
EXPOSURE CONTRASTS: INDIA

F1: 21 µg/m³  F2: 27 µg/m³  B: 75 µg/m³

EXPOSURE CONTRASTS: RWANDA

EXPOSURE CONTRASTS: GUATEMALA

F2: 34 µg/m³  F1: 41 µg/m³

B: 161 µg/m³

Notes and updates

Exposure contrasts were generally large and fell on steep part of exposure-response curves

Adoption of LPG near exclusive based on SUMs and reported/anecdotal evidence

Well characterized exposure-response relationships useful for entire sector

HAPIN trial is underway and the first measurement of children are starting

Conducting an intensive subsample (funded by ISN and NIH) to develop exposure prediction estimates
Thank you to our funders, field staffs, and to the participants who graciously accepted our researchers into their homes. Data for Peru was provided as from the Cardiopulmonary Outcomes and Household Air Pollution (CHAP) Trial (www.ncbi.nlm.nih.gov/pubmed/29100550).